Physical and Psychological Health Outcomes of Qigong Exercise in Older Adults: A Systematic Review and Meta-Analysis

Pei-Shiun Chang,[a] Tish Knobf,[b] Byeongsang Oh,[c] Marjorie Funk,[b]

[a] *School of Nursing, Indiana University at Bloomington, Indiana 47405, USA*

[b] *School of Nursing, Yale University, Connecticut 06511, USA*

[c] *Royal North Shore Hospital, Sydney Medical School, University of Sydney, NSW, Australia*

Corresponding author: Pei-Shiun Chang, Assistant Professor; Indiana University School of Nursing, 1033 E. Third Street, Sycamore Hall 444, Bloomington, Indiana 47405, USA; Tel: (+001) 812-855-0757; Fax: (+001) 812-855-6986; E-mail: pc21@indiana.edu

Running Title: HEALTH PROMOTION OF QIGONG EXERCISE

Word counts: 244 (abstract), 3320 (main text), 29 pages, 3 tables, 2 figures

This is the author's manuscript of the article published in final edited form as:

Chang, P. S., Knobf, T., Oh, B., & Funk, M. (2019). Physical and psychological health outcomes of Qigong exercise in older adults: a systematic review and meta-analysis. The American Journal of Chinese Medicine, 47(02), 301-322. https://doi.org/10.1142/S0192415X19500149

Abstract: Physical limitations, depression, and anxiety are prevalent among older adults. Mild to moderate exercise can promote physical and psychological health and reduce the risk of chronic diseases. Qigong, a type of Chinese traditional medicine exercise, has demonstrated beneficial effects on physical ability and mental health in adults with chronic conditions. The purpose of this review was to systematically assess the effects of Qigong exercise on physical and psychological health outcomes in older adults. A total of 1,282 older adults aged 62 to 83 years with depressive symptoms, frailty, or chronic medical illnesses were included in this review. The meta-analysis showed that Qigong exercise resulted in significantly improved physical ability compared with active control or usual care (standardized mean difference [SMD] =1.00 and 1.20, respectively). The pooled effects of studies with thrice weekly Qigong sessions had the greatest effect (SMD=1.65) on physical ability in older adults. Lower quality studies had larger effect sizes than those with high quality. Although Qigong exercise showed favorable effects on depression, balance, and functioning, the overall effects did not reach statistical significance. No significant adverse events were reported. The findings suggest that Qigong exercise may be an option for older adults to improve physical ability, functional ability, balance, and to lessen depression and anxiety. However, the number of RCTs that enroll older adults is limited. More methodologically sound RCTs are needed to confirm the efficacy of Qigong exercise on physical and psychological health in older adults with chronic illnesses.

Key words: Qigong, balance; depression; functional ability; 6-minute walk test; physical ability.

Introduction

Older adults often face physical and psychological health challenges as a result of the normal aging process and multiple chronic conditions. Approximately 18 million adults older than 65 years have physical limitations (Centers for Disease Control, 2009). Fifty-two percent reported having problems walking, grasping, carrying or pushing (Brault *et al.*, 2009); 75.3% had balance impairment, and the percentage increased to 89% for those over 80 years (Dillon *et al.*, 2010). Physical limitations and balance impairment contribute to lower functional ability that compromises the independence of older adults (McGuire *et al.*, 2007; Brault *et al.*, 2009; Salzman, 2010).

Psychological symptoms are commonly experienced in later life. Depression has been reported in 4.5% to 37.4% of adults older than 75 years (Geristric Mental Health Foundation, 2013). Depression is associated with increased risk of morbidity; decreased physical, cognitive, and social functioning; and greater self-neglect – all of which contribute to increased mortality (Penninx *et al.*, 1999; Cooper *et al.*, 2011; Hamer *et al.*, 2011). Anxiety often coexists with depression in the older population (King-Kallimanis *et al.*, 2009). Anxiety has been reported in 15% of non-depressed older adults and 43% of those with depression (Mehta *et al.*, 2003). Depression and anxiety were found to be strongly associated with increased physical disability and diminished well-being of older adults (McGuire *et al.*, 2007; Brault *et al.*, 2009; Salzman, 2010).

Regular physical activity and exercise can improve physical and functional ability and psychological outcomes in adults of all ages (Chou *et al.*, 2012). Older adults, however, need exercise programs that correspond to age-related changes. Alternative forms of exercise with low impact, low demands on the muscles, and less energy expenditure may offer a potentially promising approach. Qigong, a Chinese traditional medicine exercise, has been suggested as a safe option for older adults with chronic conditions, physical limitations, or low levels of activity

(Jahnke *et al.*, 2010; Chan *et al.*, 2012). It consists of gentle movements, breathing exercise, and meditation. Qigong exercise has been found to improve muscle strength, endurance, and flexibility and balance, as well as to prevent falls in the aged (Rogers *et al.*, 2009; Jahnke *et al.*, 2010; Chang *et al.*, 2018). Qigong exercise also has beneficial effects on depressive symptoms and psychological well-being in older adults (Huo, 2010; Jin, 2010; Oh *et al.*, 2010; Chang *et al.*, 2018), comparable to aerobic exercise (Wang *et al.*, 2013). Despite the gentleness of Qigong exercise, the aerobic effects fall within the moderate-intensity level of exercise related to cardio-respiratory response (Lan *et al.*, 2004; Taylor-Piliae and Froelicher, 2004). However, there is no known systematic evaluation of the physical and psychological effects of Qigong exercise in the older population. The purpose of this systematic review is to describe and synthesize the effects of Qigong randomized controlled trials (RCTs) on physical ability, functional ability, balance, depression, and anxiety in older adults.

Methods

Search Strategy

A literature search was conducted to identify potential Qigong research articles published through September 2016. The key words used for the search were ‘Qigong’ and ‘old adults’ or ‘elderly’ and limited to ‘randomized controlled trial’ in the CINAHL, PubMed, AMED, and Scopus databases. No date restrictions were used to filter the searches.

Study Selection

Articles that investigated the effects of Qigong interventions on physical and psychological outcomes with RCT design were included initially. A set of exclusion criteria was established for

further filtering the articles. We excluded articles that: (1) were not published in English; (2) had the mean age of study participants less than 60 years; (3) were commentary, reviews, meta-analyses, Qigong protocol, and qualitative research; (4) used Tai Chi Qigong, Qigong massage, laughing Qigong and external Qigong as an intervention. Studies using Tai chi Qigong were excluded because the independent effect of Qigong cannot be determined when it is combined with Tai chi. Furthermore, Qigong massage and External Qigong rely on a trained Qigong master to emit and circulate Qi, the vital energy, on participants for treatment; the theory of laughing Qigong is to use the individual's own voice to synchronize and re-establish the balance of the vital energy circulation (Chan *et al.*, 2012). Hence, the underlying mechanisms of these Qigong methods are different from Qigong exercise that this review was designed to explore.

Data Extraction and Synthesis

Information on the study sample, medical conditions, interventions, intervention duration, physical and psychological outcomes measured, and primary results were extracted using an investigator-designed data extraction form. Two reviewers (PC, RS) extracted data independently. Included studies were reported based on the Preferred Reporting Items for Systematic Reviews and Meta-Analysis Protocols (PRISMA) (Moher *et al.*, 2009).

Extracted data were synthesized using meta-analytical methods. The data that could not be included in the meta-analysis were summarized in narrative form. RevMan 5.3 software, provided by the Cochrane Collaboration (Oxford, United Kingdom), was used for meta-analysis. The intervention effect was defined as the standardized mean differences (SMD) and a 95% confidence interval (CI) of the post-intervention scores. Each outcome was tested for heterogeneity using a chi-square test and I^2 statistic. A I^2 value greater than 50% indicates significant heterogeneity in which the random effects model was used, as the weights given to the individual studies were more even and the summary effect was more conservative. The

fixed effects model was used when no heterogeneity was detected. Data in relation to physical and psychological outcomes were analyzed in two separate comparisons between Qigong and active (e.g., daily walking or yoga) and non-active (e.g., reading newspapers or usual care) control interventions. Funnel plots were not used to assess publication bias, as no more than 10 studies were included for each comparison. Subgroup analyses were stratified and pooled by types, frequency, duration of Qigong interventions, active and non-active comparison groups, and quality of the study.

Assessment of Risk of Bias (ROB) in Individual Studies

Two reviewers (PC, RS) independently evaluated the ROB using The Cochrane Collaboration's tool for assessing risk of bias (Higgins and Green, 2011). Selection bias, performance bias, detection bias, attrition bias, reporting bias, and other potential sources of bias were evaluated in all included studies and rated as yes, no, and unclear. Discrepancies were discussed with a third reviewer (BO) to reach a consensus.

Results

Eligible Studies

One hundred and eight articles were initially identified. Duplicated articles (N=20) were eliminated. Ninety-eight full-text articles were located and their abstracts reviewed for inclusion. The final number of studies meeting the criteria was 14 (Figure 1).

Characteristics of Studies, Individuals, and Interventions

The data from the 14 studies are summarized in Table 1. Five studies were conducted in Hong Kong, three in China, one in Australia, three in Germany, one in Spain, and one in the United States. Two trials only investigated the effects of Qigong exercise on physical and functional ability. Three examined the effects on only depression and anxiety, and nine assessed both psychological and physical outcomes.

There were several types of Qigong exercise in the 14 RCTs, including the combination of Eight-Section Brocades and Yijin Jing, Medical Qigong, Baduanjin (Health Qigong), Dantian and Nei Yang Gong, Liuzijue Qigong, Hu Yue Xian, and modified Yijin Jing. These Qigong exercises have mutual components – slow body movements, breathing exercise, and meditation. One of 14 studies (Campo *et al.*, 2013) did not report the forms of Qigong exercise. The comparable interventions in the control groups were newspaper reading, daily walking, a combination of daily walking and breathing exercise, usual care, exercise therapy, aerobic training, and Viniyoga.

Qigong exercise was studied in populations with Parkinson's disease, chronic neck pain, chronic low back pain, major depressive disorder, chronic obstructive pulmonary disease (COPD), post-orthopedic surgery, and prostate cancer. The length of the Qigong interventions ranged from four days to six months, with a median duration of three months for studies assessing psychological outcomes and physical and functional ability. The duration of the individual sessions ranged from 30 to 90 minutes, frequency from one to four times per week, and the intervention dosage from 180 to 4,320 minutes.

Outcome Measurements

The 6-minute walk test (6-MWT), Unified Parkinson's Disease Rating Scale III (UPDRS-III), the physical component of Medical Outcomes 36-item Short Form Health Survey (SF-36), Self-Concept Scale (SCS), and handgrip strength were used to evaluate physical ability. The

Monitored Functional Task Evaluation (MFTE), gait speed, lower leg muscle strength, the Functional Assessment of Cancer Therapy-General (FACT-G), and Hannover Functional Ability Questionnaire for measuring pain-related disability (FFbHR) were used to determine functional ability. Berg Balance Scale (BBS), Tinetti Test, and Timed Up & Go were used to assess balance.

A total of 13 different measures, including two objective measures, were used to evaluate depression and anxiety outcomes: cortisol and serotonin levels, SF-36, Geriatric Depression Scale (GDS), Hospital Anxiety and Depression Scale (HADS), FACT-G, Hamilton Rating Scale of Depression (HRSD), Self-rating Depression Scale (SDS), Montgomery Asberg Depression Rating Scale (MADRS), Allgemeine Depression Scale (ADS), Regulatory Emotion Self-Efficacy Questionnaire (RESE), and the Brief Symptom Inventory (BSI-18).

Methodological Quality of Studies and Bias Risk

The assessment of ROB is summarized in Table 2. Overall quality of the studies was fair; yet, due to insufficient information, the ROB in one study (Tsang *et al.*, 2003) was unclear. The concealment of allocation was often omitted and only seven studies reported the intervention allocation concealment. Given the nature of the Qigong exercise, most studies (93.3%) were unable to blind the interventions to participants.

Effects on Physical Ability

All studies that investigated the effects of Qigong exercise on physical and functional ability reported significant intergroup or within-group effects (Table 1). Three RCTs evaluated balance as an outcome and one reported significant effects on balance compared with the control group (Xiao and Zhuang, 2016).

Ten RCTs reported physical ability outcomes (Schmitz-Hubsch *et al.*, 2006; Tsang *et al.*, 2006; von Trott *et al.*, 2009; Ng *et al.*, 2011; Tsang *et al.*, 2013; Tsang *et al.*, 2013; Xiao and Zhuang, 2015; Teut *et al.*, 2016; Xiao and Zhuang, 2016; Zhang *et al.*, 2016), and concluded that Qigong exercise groups performed better on the 6-MWT (SMD=1.00 [95% CI, 0.21-1.80], I2=91%) compared with the active and non-active control groups (Figure 2a, 2b). Handgrip strength favored the Qigong groups (SMD=0.34 [95% CI, 0.08-0.61], I2=0%) and no heterogeneity was detected (Figure 2c).

Effects on Functional Ability

Functional ability outcomes were reported in seven RCTs (von Trott *et al.*, 2009; Ng *et al.*, 2011; Oh *et al.*, 2012; Tsang *et al.*, 2013; Xiao and Zhuang, 2015; Teut *et al.*, 2016; Xiao and Zhuang, 2016), but one was excluded due to insufficient data reported (Tsang *et al.*, 2013). Qigong exercise groups showed better performance on MFTE (SMD=1.64 [95% CI, 1.28-2.01], I2=97%), compared with the active control groups. The pooled effects of all four RCTs (von Trott *et al.*, 2009; Ng *et al.*, 2011; Xiao and Zhuang, 2015; Teut *et al.*, 2016) on functional ability demonstrated the direction of effects towards the Qigong interventions rather than yoga, exercise therapy or daily walk (Figure 2d).

Effects on Balance

Balance outcomes were reported in three RCTs (Tsang *et al.*, 2013; Teut *et al.*, 2016; Xiao and Zhuang, 2016). When combining all three RCTs in pooled analysis, the direction of effects on balance favored the Qigong intervention compared with the controls, but since the 95% confidence interval includes zero, the difference was not statistically significant (SMD=-0.26 [95% CI, -0.73 - 0.21], I2=74%)(Figure 2e).

Effects on Depression and Anxiety

Eleven RCTs reported depression outcomes (Tsang *et al.*, 2003; Schmitz-Hubsch *et al.*, 2006; Tsang *et al.*, 2006; von Trott *et al.*, 2009; Ng *et al.*, 2011; Campo *et al.*, 2013; Tsang *et al.*, 2013; Tsang *et al.*, 2013; Martínez *et al.*, 2015; Xiao and Zhuang, 2015; Teut *et al.*, 2016) and six reported depression and anxiety or mental health (von Trott *et al.*, 2009; Ng *et al.*, 2011; Campo *et al.*, 2013; Tsang *et al.*, 2013; Xiao and Zhuang, 2015; Teut *et al.*, 2016). There was insufficient evidence to support improved depression or mental health for those in the Qigong intervention, compared with active (SMD=0.25 [95% CI, -0.06-0.56], I2= 0% and SMD= -0.11 [95% CI, -0.32-0.10], I2= 0%, respectively) (Figure 2f), and non-active controls (SMD= -0.52 [95% CI, -1.08-0.04], I2= 86% and (SMD= -0.03 [95% CI,-0.33-0.27], I2= 0%, respectively) (Figure 2g). Although not significant, the direction of effects on depression favored the Qigong interventions (Figure 2g). Only three RCTs (Schmitz-Hubsch *et al.*, 2006; Campo *et al.*, 2013; Zhang *et al.*, 2016) reported anxiety outcomes using three different measures, intervention dosage, health conditions, and forms of Qigong exercise, with two reporting significantly improved anxiety scores (Campo *et al.*, 2013; Zhang *et al.*, 2016) and one with decreased, but statistically insignificant, anxiety scores (Schmitz-Hubsch *et al.*, 2006).

Subgroup Analysis

The subgroup analysis demonstrates no significant group differences in types of Qigong interventions, intervention duration, weekly class frequency, types of control interventions, and quality of the study. However, significant overall effects on post-intervention physical ability were found when comparing with the control groups, except the subgroups for the intervention duration of 4,320 minutes and the intervention types of yoga, exercise therapy, and daily

walking (Table 3). RCTs with class frequency of three times weekly (SMD=1.65, p=.02) or intervention duration of 4,320 minutes (SMD=1.37, p=.06) generated higher effects in physical ability. The intervention duration of 1,500 to 2,000 minutes shows significant overall effects on physical ability of older adults. RCTs with some risk of bias tend to have a higher mean SMD (0.84) than those with low risk of bias (0.57). Liuzijue, Yijinjing, and Dantian Qigong, compared with Health Qigong (SMD=0.57), could benefit older adults more in functional ability (SMD=0.81).

Safety and Adverse Events

Five of 14 RCTs reported on adverse events (AEs). Four stated that no AEs occurred in either intervention or control groups (Tsang *et al.*, 2013; Tsang *et al.*, 2013; Martínez *et al.*, 2015; Xiao and Zhuang, 2015; Xiao and Zhuang, 2016). One reported that four participants experienced nausea, muscle ache, and muscle tension (von Trott *et al.*, 2009).

Discussion

The systematic review and meta-analysis demonstrate the potential effects of Qigong exercise on physical ability, functional ability, and balance in older adults with chronic illness. Although there was insufficient evidence to support that Qigong exercise is better than yoga, daily walking, and exercise therapy to improve depression and overall metal health, over 80% of individual RCTs reported significant psychological and physical effects of Qigong exercise. Qigong exercise is considered safe for older adults, as no significant AEs were reported.

The data suggest that Qigong exercise improves physical ability in older adults. Specifically, Qigong exercise significantly improved the distances of the 6-MWT in older adults compared with usual care or daily walking. However, improvement in physical ability appears to

be influenced by the type of Qigong exercise and the intervention dosage. The subgroup analysis suggests that older adults benefit more from practicing Health Qigong, Liuzijue, Yijinjing, or Dantian Qigong three times weekly for a total of 1,500 to 2,000 minutes. The higher weekly class frequency does not lead to proportionally increased physical ability in older adults.

Although the pooled effects of Qigong exercise (von Trott *et al.*, 2009; Ng *et al.*, 2011; Xiao and Zhuang, 2015; Teut *et al.*, 2016) on functional ability among older adults with chronic pain or COPD were not statistically different from yoga, exercise therapy, or daily walking, ($p=0.10$) and significant heterogeneity was detected (Figure 2d), the direction of effects favored the Qigong interventions. Objective or subjective measures could result in the significant heterogeneity, because the overall effects became significant when comparing RCTs with objective measures independently. Although the subgroup analysis did not show significant effects, Liuzijue, Yijinjing and Dantian Qigong seem to produce increased effect in functioning than Health Qigong.

Although the pooled effects of Qigong exercise on balance did not show statistically significant differences from control interventions ($p=0.27$), the Qigong exercise appears to be more helpful than usual care or daily walking in terms of improving balance in older adults (Figure 2e). Significant heterogeneity was detected, which may be related to diverse forms and durations of Qigong interventions and different health conditions among older adults.

More than 50% of individual RCTs reported reduced depression and anxiety symptoms. Although not quite significant ($p=0.07$), the pooled analysis showed that the direction of effects on depression favored Qigong interventions, which is consistent with a previous Qigong review in adult populations (Wang *et al.*, 2013). However, significant heterogeneity was noted and might be related to subjective psychological outcome measure (GDS) and subjects' different cultural backgrounds. Culture may influence participants' emotional expression and lead to the heterogeneity of depression outcome measures. An observation regarding the role of culture in expressing individuals' moods was reported in a Chinese study (Tsang *et al.*, 2003).

Possible explanations of the heterogeneity in this review include subjects' differences (health conditions or cultural backgrounds), various outcome measures, and different risk of bias (Sun *et al*., 2014). Yet, subgroup analysis of this review was unable to fully explain the heterogeneity across studies (Table 3). Despite no significant subgroup differences in the quality of studies, the subgroup analysis revealed that the observed effect of Qigong interventions might be influenced by the study quality. Low quality studies were more likely to report increased effect than those of higher quality, which is consistent with a previous review (Wu *et al*., 2015). Randomization sequence generation, allocation concealment, power analysis, management of the missing data, and blinding of outcome assessment were often unclear among included RCTs. Problems with sequence generation and adequate sample size can affect the accuracy of the RCT results due to lack of comparability between Qigong and control groups, which further compromises the precision of the pooled results in this review. The absence of allocation concealment was previously reported to increase intervention effect estimates by 30-40% (Schulz *et al*., 1995), which is consistent with our subgroup analysis.

Limitations and Suggestions for Future Research

There are several limitations to this systematic review. Most studies were conducted in Asia and the review was limited to English-language studies. The limited number of RCTs; the heterogeneity in outcome measurements, Qigong interventions, intervention durations; frequency of weekly class; and varied methodological rigor make it difficult to determine the effectiveness of Qigong exercise on physical and psychological outcomes in older adults and to recommend minimum effective dosage, types, intensity, or format (sitting or standing) for older adults. Similar challenges of identifying Qigong intervention characteristics were reported previously as well (Wu *et al.*, 2015). It is also noted that the existing RCTs examining the

efficacy of Qigong exercise on the health of older adults is limited, with only 14 studies included in this review. Only one RCT (Campo *et al.*, 2013) included American older adults.

More methodologically rigorous trials with objective measures and older adults with various cultural backgrounds are needed to address needs in promoting physical ability, psychological health, functioning, and balance in older adults. Based on the evidence in this review, we cannot recommend the best form of Qigong exercise for older adults, although Health Qigong is the most common in the included RCTs and its feasibility, acceptability, and preliminary effects have been recently tested in American adults 65 to 85 years of age (Chang *et al*., 2018). The older adults in this study reported that Health Qigong was physically acceptable, easy to learn and to incorporate into their daily life, and benefited their balance and flexibility, bringing them a feeling of calm and relaxation after eight weeks of practice (Chang *et al*., 2018). Future research is encouraged to include Health Qigong in more rigorous RCTs, and continue to investigate its effects on the physical and psychological health of older adults.

Conclusion

This review demonstrated that Qigong may be an exercise option with favorable effects on physical and functional ability, balance, depression, and anxiety for older adults with chronic health conditions. Our findings suggest an optimum intervention duration of at least 1,500 to 2,000 minutes and practice frequency of three times weekly for improving physical ability in older adults. Future studies with rigorous methods are needed to confirm Qigong effects on psychological health, balance, and functioning.

Acknowledgements

We thank Dr. Giorgos Bakoyannis for his valuable comments on data analysis and Rebecca Serfass (RS) for reviewing methodological quality and risk of bias in all studies. This work was supported by the Yale School of Nursing Doctoral Fellowship and Indiana University School of Nursing Faculty Development Fund.

Conflict of Interest:

The authors have no conflicts of interest to declare.

Author Contributions:

PC, TK, and MF contributed to the conception and design of this review and data synthesis. BO contributed to the design of this review and data extraction. PC conducted the review of studies and assessed methodological quality and risk of bias. All authors were involved in writing of the manuscript and approved the final manuscript.

Sponsor's Role:

The sponsors had no role in the process of conducting this review.

References

Brault, M., J. Hootman, C. Helmick, K. Theis and B. Armour. Prevalence and most common causes of disability among adults-United States, 2005. *MMWR. Wkly. Rep.* 58: 421-426, 2009.

Campo, R.A., N. Agarwal, P.C. LaStayo, K. O'Connor, L. Pappas, K.M. Boucher, . . . and A.Y. Kinney. Levels of fatigue and distress in senior prostate cancer survivors enrolled in a 12-week randomized controlled trial of Qigong. *J. Cancer Surviv.* 8: 60-69, 2013.

Centers for Disease Control. *Prevalence and most common causes of disability among adults---United States, 2005*. Retrieved from Atlanta, GA: Centers for Disease Control and Prevention, 2009.

Chan, C.L., C.-W. Wang, R.T. Ho, S.-M. Ng, E.T. Ziea and V.T. Wong. Qigong exercise for the treatment of fibromyalgia: A systematic review of randomized controlled trials. *J. Altern. Complement. Med.* 18: 641-646, 2012.

Chan, C.L., C.W. Wang, R.T. Ho, A.H. Ho, E.T. Ziea, V.C. Taam Wong and S.M. Ng. A systematic review of the effectiveness of qigong exercise in cardiac rehabilitation. *Am. J. Chin. Med.* 40: 255-267, 2012. doi:10.1142/s0192415x12500206

Chang, P., M.T. Knobf, M. Funk and B. Oh. Feasibility and acceptabiliy of Qigong exercise in community-dwelling older adults in the United States. *J. Altern. Complement. Med.* 24: 48-54, 2018.

Chang, P., M.T. Knobf, B. Oh and M. Funk. Physical and psychological effects of Qigong exercsie in community-dwelling older adults: An exploratory study. *Geriatr Nurs.* 39: 88-94, 2018.

Chou, C.-H., C.-L. Hwang and Y.-T. Wu. Effect of exercise on physical function, daily living activities, and quality of life in the frail older adults: A meta-analysis. *Arch. Phys. Med. Rehabil.* 93: 237-244, 2012. doi:http://doi.org/10.1016/j.apmr.2011.08.042

Cooper, C., C. Katona, K. Lyketsos, D. Blazer, H. Brodaty, P. Rabins, . . . and G. Livingston. systematic review of treatments for refractory depression in older people. *Am. J. Psychiatry.* 168: 681-688, 2011.

Dillon, C.F., Q. Gu, H.J. Hoffman and C.-W. Ko. Vision, hearing, balance, and sensory impairment in Americans aged 70 years and over: United States, 1999-2006. *NCHS Data Brief*: 1-8, 2010.

Geriatric Mental Health Foundation. Late life depression. Retrieved from http://www.gmhfonline.org/gmhf/consumer/factsheets/depression_factsheet.html. Accessed April, 2014.

Hamer, M., C.J. Bates and G.D. Mishra. Depression, physical function, and risk of mortality: National Diet and Nutrition Survey in adults older than 65 years. *Am. J. Geriatr. Psychiatry.* 19: 72-78, 2011.

Higgins, J.P.T. and S. Green. Cochrane Handbook for Systematic Reviews of Interventions Version 5.1.0. *The Cochrane Collaboration*. Retrieved from, 2011. doi:http://handbook.cochrane.org

Huo, R. *Study on Effect of Qigong Baduanjin on Quality of Life and Depression of Patients with Type 2 Diabetes Mellitus Comorbid Depression in Community.* Beijing, China: Beijing University of Chinese Medicine, 2010.

Jahnke, R., L. Larkey, C. Rogers, J. Etnier and F. Lin. A comprehensive review of health benefits of Qigong and Tai Chi. *Am. J. Health Promot.* 24: e1-e25, 2010. doi:10.4278/ajhp.081013-LIT-248

Jahnke, R.A., L.K. Larkey and C. Rogers. Dissemination and benefits of a replicable Tai Chi and Qigong program for older adults. *Geriatr. Nurs.* 31: 272-280, 2010.

Jin, X. *The Comparison Study of Body-building among Health Qigong, Tai chi and Yangko to the Elderly*. Hebei, China: Heibei Normal University, 2010.

King-Kallimanis, B., A.M. Gum and R. Kohn. Comorbidity of depressive and anxiety disorders for older Americans in the national comorbidity survey-replication. *Am. J. Geriatr. Psychiatry.* 17: 782-792, 2009.

Lan, C., S.-W. Chou, S.-Y. Chen, J.-S. Lai and M.-K. Wong. The aerobic capacity and ventilatory efficiency during exercise in qigong and tai chi chuan practitioners. *Am. J. Chin. Med.* 32: 141-150, 2004.

Martínez, N., C. Martorell, L. Espinosa, V. Marasigan, S. Domènech and M. Inzitari. Impact of Qigong on quality of life, pain and depressive symptoms in older adults admitted to an intermediate care rehabilitation unit: a randomized controlled trial. *Aging Clin. Exp. Res.* 27: 125-130, 2015. doi:10.1007/s40520-014-0250-y

McGuire, L.C., T.W. Strine and C.A. Okoro. Healthy lifestyle behaviors among older adults with and without disabilities. *Prev. Chronic Dis.* 4: 1-11, 2007.

Mehta, K.M., E.M. Simonsick, B.W. Penninx, R. Schulz, S.M. Rubin, S. Satterfield and K. Yaffe. Prevalence and correlates of anxiety symptoms in well-functioning older adults: Findings from the health aging and body composition study. *J. Am. Geriatr. Soc.* 51: 499-504, 2003.

Moher, D., A. Liberati, J. Tetzlaff, D.G. Altman and P. Group. Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. *Ann. Intern. Med.* 151: 264-269, W264, 2009.

Ng, B.H., H.W. Tsang, A.Y. Jones, C.T. So and T.Y. Mok. Functional and psychosocial effects of health qigong in patients with COPD: A randomized controlled trial. *J. Altern. Complement. Med.* 17: 243-251, 2011. doi:10.1089/acm.2010.0215

Oh, B., P. Butow, B. Mullan, S. Clarke, P. Beale, N. Pavlakis, . . . and D. Rosenthal. Impact of medical Qigong on quality of life, fatigue, mood and inflammation in cancer patients: A randomized controlled trial. *Ann. Oncol.* 21: 608-614, 2010. doi:10.1093/annonc/mdp479

Oh, B., P.N. Butow, B.A. Mullan, S.J. Clarke, P.J. Beale, N. Pavlakis, . . . and J. Vardy. Effect of medical Qigong on cognitive function, quality of life, and a biomarker of inflammation in cancer patients: a randomized controlled trial. *Support. Care Cancer.* 20: 1235-1242, 2012. doi:10.1007/s00520-011-1209-6

Penninx, B.W., S. Leveille, L. Ferrucci, J. Van Eijk and J.M. Guralnik. Exploring the effect of depression on physical disability: Longitudinal evidence from the established populations for epidemiologic studies of the elderly. *Am. J. Public Health.* 89: 1346-1352, 1999.

Rogers, C.E., L.K. Larkey and C. Keller. A review of clinical trials of tai chi and qigong in older adults. *West J. Nurs. Res.* 31: 245-279, 2009.

Salzman, B. Gait and balance disorders in older adults. *Am. Fam. Physician.* 82: 61-68, 2010.

Schmitz-Hubsch, T., D. Pyfer, K. Kielwein, R. Fimmers, T. Klockgether and U. Wullner. Qigong exercise for the symptoms of Parkinson's disease: A randomized, controlled pilot study. *Mov. Disord.* 21: 543-548, 2006. doi:10.1002/mds.20705

Schulz, K.F., I. Chalmers, R.J. Hayes and D.G. Altman. Empirical evidence of bias: Dimensions of methodological quality associated with estimates of treatment effects in controlled trials. *JAMA.* 273: 408-412, 1995.

Sun, X., J.P. Ioannidis, T. Agoritsas, A.C. Alba and G. Guyatt. How to use a subgroup analysis: Users' guide to the medical literature. *JAMA.* 311: 405-411, 2014. doi:10.1001/jama.2013.285063

Taylor-Piliae, R.E. and E.S. Froelicher. The effectiveness of tai chi exercise in improving aerobic capacity: Meta-analysis. *J. Cardiovas. Nurs.* 1948-57, 2004.

Teut, M., J. Knilli, D. Daus, S. Roll and C.M. Witt. Qigong or Yoga versus no intervention in older adults with chronic low back pain—A randomized controlled trial. *J. Pain.* 17: 796-805, 2016. doi:https://doi.org/10.1016/j.jpain.2016.03.003

Tsang, H., K. Fung, A. Chan, G. Lee and F. Chan. Effect of a Qigong exercise programme on elderly with depression. *Int. J. Geriatr. Psychiatry.* 21890-897, 2006.

Tsang, H.W., C.K. Mok, Y.T. Au Yeung and S.Y. Chan. The effect of Qigong on general and psychosocial health of elderly with chronic physical illnesses: A randomized clinical trial. *Int. J. Geriatr. Psychiatry.* 18: 441-449, 2003. doi:10.1002/gps.861

Tsang, H.W., W.W. Tsang, A.Y. Jones, K.M. Fung, A.H. Chan, E.P. Chan and D.W. Au. Psycho-physical and neurophysiological effects of qigong on depressed elders with chronic illness. *Aging Ment. Health.* 17: 336-348, 2013.

Tsang, H.W.H., J.L.C. Lee, D.W.H. Au, K.K.W. Wong and K.W. Lai. Developing and testing the effectiveness of a novel Health Qigong for frail elders in Hong Kong: A preliminary study. *Evid. Based Complement. Altern. Med.* 201311, 2013. doi:10.1155/2013/827392

von Trott, P., A.M. Wiedemann, R. Ludtke, A. Reishauer, S.N. Willich and C.M. Witt. Qigong and exercise therapy for elderly patients with chronic neck pain (QIBANE): A randomized controlled study. *J. Pain.* 10: 501-508, 2009. doi:10.1016/j.jpain.2008.11.004

Wang, C., C.L.W. Chan, R.T.H. Ho, H.W.H. Tsang, C.H.Y. Chan and S. Ng. The effect of Qigong on depression and anxiety symptoms: A systematic review and meta-analysis of randomized contrlled trials. *Evid. Based Complement. Altern. Med.* 2013: 1-13, 2013. Wu, W.-W., E. Kwong, X.-Y. Lan and X.-Y. Jiang. The Effect of a meditative movement intervention on quality of sleep in the elderly: A systematic review and meta-analysis. *J. Altern. Complement. Med.* 21: 509-519, 2015. doi:10.1089/acm.2014.0251

Xiao, C.-M. and Y.-C. Zhuang. Effect of health Baduanjin Qigong for mild to moderate Parkinson's disease. *Geriatr. Gerontol. Int.* 16: 911-919, 2016. doi:10.1111/ggi.12571

Xiao, C.M. and Y.C. Zhuang. Efficacy of Liuzijue Qigong in individuals with chronic obstructive pulmonary disease in remission. *J. Am. Geriatr. Soc.* 63: 1420-1425, 2015.

Zhang, M., G. Xv, C. Luo, D. Meng and Y. Ji. Qigong Yi Jinjing promotes pulmonary function, physical activity, quality of life and emotion regulation self-efficacy in patients with chronic obstructive pulmonary disease: A pilot study. *J Altern. Complement. Med.* 22: 810-817, 2016. doi:10.1089/acm.2015.0224

Figure Legends

Figure 1. Flowchart of Paper Selection (RCT=randomized controlled trial)

Figure 2. Forest Plots of Effect Estimates of Qigong Exercise versus Controls on Physical Ability, Functional Ability, Balance, and Depression

a. 6MWT: Qigong vs. Active Controls

b. 6MWT: Qigong vs. Non-active Controls

c. Handgrip Strength: Qigong vs. Controls

d. Functional ability: Qigong vs. Active Controls

e. Balance: Qigong vs. Controls

f. GDS: Qigong vs. Active Controls

g. GDS: Qigong vs. Non-active Controls

Note. CI=confidence interval; SD=standard deviation; Std.=standardized; IV=independent variable; GDS=Geriatric Depression Scale.

Table 1. Summary of the Physical and Psychological Effects of Qigong Exercise in RCTs

Authors, Year, and Location	Sample Size (N), Mean Age (SD), and Study Population	Intervention Groups	Duration (min. x week)	Outcome Measures	Main Results
Effects on Physical and Functional Ability					
Population with Frailty					
Tsang et al., 2013 Hong Kong	N=134 Mean age=83 (6.0) Frail older adults	I: Health Qigong (Eight-Section Brocades& Yijin Jing) (n=69) C: Newspaper reading (n=65)	60 min. x 2 times per week x 12 weeks	Handgrip strength Timed Up and Go	No significant differences on handgrip strength and Timed Up & Go. There was a trend of improvement shown in the Qigong group but not in the control group.
Population with Cancer					
Oh et al., 2012 Australia	N=81 Mean age=62 (12.0) Cancer	I: Medical Qigong (n=37) C: Usual care (n=44)	90 min. x 2 times per week x 10 weeks	FACT-G	Qigong group reported significantly improvement in physical and functional well-being (p<.001).
Population with Psychological Problems					
Tsang et al., 2013 Hong Kong	N=38 Mean age=79.7 (6.55) Major depressive disorder	I: Health Qigong (Eight-Section Brocades protocol)(n=21) C: Newspaper reading & discussion (n=17)	45 min. x 3 times per week X 12 weeks	Handgrip strength Lower leg muscle strength	Right handgrip strength significantly improved in the Qigong group (p=.034). No significant difference was found on left handgrip strength and lower leg muscle strength in two groups.
Tsang et al., 2006 Hong Kong	N=82 Mean age=82.11 (7.2) Depression	I: Baduanjin (n=48) C: Newspaper reading (n=34)	30-45 min. x 3 times per week x 16 weeks	SCS	The Qigong group had significantly improved physical well-being (p=.001).
Population with Chronic Medical Problems					
Ng et al., 2011 Hong Kong	N=80 Mean age=71.8 (1.05) COPD	I: Health Qigong (Baduanjin) (n=40) C: Breathing and walking exercise (n=40)	45 min. x 4 times	6MWT MFTE	Physical capacity (p<.001) and functional ability (p=.02) significantly improved in the Qigong group. Qigong group better maintained functional ability gained from a pulmonary rehabilitation program until 6 months than the control group.
Xiao & Zhuang, 2016 China	N=96 Mean age=67.53 (8.56) Mild to moderate Parkinson Disease	I: Bajuanjin Qigong and daily walking (n=48) C: Daily walking (n=48)	45 min. x 4 times per week X 6 months	BBS Timed Up & Go 6MWT Gait speed	Balance (p=.041), physical capacity (p=.042), and gait speed (p=.011) significantly improved in the Qigong group.
Teut et al., 2016 Germany	N=176 Mean age=73 (5.6) Chronic low back pain	I: Dantian and Nei Yang Gong (n=58) C1: Viniyoga (n=61) C2: Usual care (n=57)	Qigong: 90 min. x 12 classes Yoga: 45 min. x 24 classes	SF-36 Tinetti Test Handgrip strength FFbHR	Compared with the usual care, back function (p=.03) and right handgrip (p=.04) significantly improved in the Qigong group, but not in the yoga group at 3 months. Although not significant, a trend of improvement on back function was shown in the Qigong group until 6 months (p=.064). There was no significant difference in balance and physical functioning between 3 groups at 6 months.
Xiao et al., 2015 China	N=126 Mean age=71.1 (2.7) COPD	I: Liuzijue Qigong & daily walk (n=63) C: Daily walk (n=63)	45 min. X 4 times a week X 6 months	6MWT MFTE	Physical capacity (p=.04) significantly improved in the Qigong group, compared to the control group. Physical functioning showed significant changes within the Qigong group after the intervention (p=.04).

Authors, Year, and Location	Sample Size (N), Mean Age (SD), and Study Population	Intervention Groups	Duration (min. x week)	Outcome Measures	Main Results
Zhang et al., 2016 China	N=148 Mean age=64.77 (11.07) COPD	I: Modified Yi Jinjing (n=42) C1: Daily walk (n=43) C3: Usual care (n=45)	60 min. x 3 times per week x 6 months	6MWT	The Qigong group walked significantly longer distances than other two groups (p<.001).
Von Trott et al., 2009 Germany	N=117 Mean age=76 (8.0) Chronic neck pain	I: Dantian Qigong (n=38) C1: Exercise therapy (n=39) C2: Waiting list (n=40)	45 min. x 2 times per week x 3 months	SF-36	There was no significant difference for physical ability between three groups.
Schmitz-Hubsch et al., 2006 Germany	N=56 Mean age=63.8 (7.5) Parkinson's disease	I: Qigong (The Eight Brocades)(n=32) C: Usual care (n=24)	60 min. x 2 times per week x 8 weeks	UPDRS-III	Physical capacity significantly improved in the Qigong group at 3 (p<.01) & 6 months (p=.0384). Postural stability in the Qigong group was significantly better than the control group (p=.0044) at 6 months.
Effects on Depression and Anxiety					
Population with Frailty					
Tsang et al., 2013 Hong Kong	N=134 Mean age=83 (6.0) Frail older adults	I: Health Qigong (Eight-Section Brocades and Yijin Jing) (n=69) C: Newspaper reading (n=65)	60 min. x 2 times per week x 12 weeks	GDS	There is no significant difference on depression between two groups, but a trend of improvement on GDS was observed in the Qigong group.
Population with Psychological Problems					
Tsang et al., 2006 Hong Kong	N=82 Mean age=82.11 (7.2) Depression	I: Baduanjin (n=48) C: Newspaper reading (n=34)	30-45 min. x 3 times per week x 16 weeks	GDS	Depression improved significantly in the Qigong group (p=.041).
Tsang et al., 2013 Hong Kong	N=38 Mean age=79.7 (6.55) Major depressive disorder	I: Health Qigong (Eight-Section Brocades protocol)(n=21) C: Newspaper reading & discussion (n=17)	45 min. x 3 times per week x 12 weeks	GDS HRSD Cortisol Level Serotonin level	Depression scores significantly improved in the Qigong group (p=.007); however, no significant difference was found on the HRSD and cortisol and serotonin levels between two groups.
Population with Chronic Medical Problems					
Teut et al., 2016 Germany	N=176 Mean age=73 (5.6) Chronic low back pain	I: Dantian and Nei Yang Gong (n=58) C1: Viniyoga (n=61) C2: Usual care (n=57)	Qigong: 90 min. x 12 classes Yoga: 45 min. x 24 classes	GDS SF-36	There was no significant improvement on depression between 3 groups after the intervention.
Martinez et al., 2015 Spain	N=58 Mean age=73 (5.2) Post-orthopedic surgery	I: Hu Yue Xian Qigong (n=29) C: Usual care (n=29)	90 min. x 2 times per week x 4 weeks	GDS	Both the Qigong group and the usual care group showed improvement on depressive symptoms (p=.502).
Xiao et al., 2015 China	N=126 Mean age=71.1 (2.7) COPD	I: Liuzijue Qigong and daily walk (n=63) C: Daily walk (n=63)	45 min. x 4 times a week x 6 months	SF-36	Mental health significantly improved in both Qigong group (p=.03) and control group (p=.02), but no intergroup changes.
Zhang et al., 2016 China	N=148 Mean age=64.77 (1.07) COPD	I: Modified Yi Jinjing (n=42) C1: Daily walk (n=43) C3: Usual care (n=45)	60 min. x 3 times per week x 6 months	RESE	The Qigong group showed more positive affect and better managed distress than the other two groups (p<.001).
Von Trott et al., 2009 Germany	N=117 Mean age=76 (8.0) Chronic neck pain	I: Dantian Qigong (n=38) C1: Exercise therapy (n=39) C2: Waiting list (n=40)	45 min. x 2 times per week x 3 months	SF-36 ADS	There was no significant difference for mental health between three groups.
Schmitz-Hubsch et al.,	N=56 Mean age=63.8 (7.5)	I: Qigong (The Eight Brocades) (n=32) C: Usual care (n=24)	60 min. x 2 times per week x 8 weeks	MADRS	There was no significant difference for depression between two groups. Anxiety and

Authors, Year, and Location	Sample Size (N), Mean Age (SD), and Study Population	Intervention Groups	Duration (min. x week)	Outcome Measures	Main Results
2006 Germany	Parkinson's disease				tension scores decreased in both groups.
Tsang et al., 2003 Hong Kong	N=50 Mean age=72.9 (9.5) Chronic physical illnesses	I: The Eight-Section Brocades and basic rehabilitation activities (n=24) C: Basic rehabilitation activities (n=26)	60 min. x 2 times per week x 12 weeks	GDS	Depression scores improved more in the Qigong group; however, no significant difference was found in depression between the two groups (p=.145).
Ng et al., 2011 Hong Kong	N=80 Mean age=71.8 (1.05) COPD	I: Health Qigong (Baduanjin) (n=40) C: Breathing and walking exercise (n=40)	45 min. x 4 times	SF-36	There was no significant difference in mental health between two groups (p=.12)
Populations with Cancer					
Campo et al., 2013 USA	N=40 Mean age=72.5 (Range: 58-90) Prostate cancer	I: Qigong (n=20) C: Stretching exercise (n=20)	60 min. x 2 times per week x 12 weeks	BSI-18	Anxiety improved significantly in the Qigong group (p=.003). A trend of improvement in depression was shown in Qigong group, but not significant (p=.09).

Note. C: control group; SD: standard deviation; COPD: chronic obstructive pulmonary disease; 6MWT: 6-minute walk test; UPDRS-III: Unified Parkinson's Disease Rating Scale; BDS: Brown's Disability Scale; MFTE: Monitored Functional Task Evaluation; SF-36: Medical Outcomes 36-item Short Form Health Survey; BBS: Berg Balance Scale; FACT-G: The Functional Assessment of Cancer Therapy-General; FFbHR: Hannover Functional Ability Questionnaire for measuring pain-related disability; SCS: Self-Concept Scale; MADRS: Montgomery Asberg Depression Rating Scale; BDI: Beck Depression Inventory; GDS: Geriatric Depression Scale; HADS: Hospital Anxiety and Depression Scale; BSI-18: Brief Symptom Inventory-18; ADS: Allgemeine Depressions Scale; HRSD: Hamilton Rating Scale of Depression; RESE: Regulatory Emotion Self-Efficacy Questionnaire.

Table 2. Risk of Bias Assessment of Included RCTs

	Random sequence generation	Allocation concealment	Blinding of participants and personnel	Blinding of outcome assessment	Incomplete outcome data	Selective outcome reporting	Other sources of bias	Total
Tsang et al, 2013	?	?	-	?	+	+	+	3
Oh et al., 2012	?	?	-	?	+	+	+	3
Campo et al., 2013	+	+	-	?	-	+	+	4
Tsang et al., 2013	+	?	-	+	+	+	+	5
Ng et al., 2011	+	+	+	+	+	+	+	7
Xiao & Zhung, 2016	?	?	-	?	+	+	+	3
Teut et al., 2016	+	+	-	?	+	+	+	5
Martinez et al., 2015	+	+	-	+	+	+	+	6
Xiao & Zhung, 2015	?	?	-	+	+	+	+	4
Zhang et al., 2016	?	?	-	+	?	+	+	3
Von Trott et al., 2009	+	+	-	+	+	+	+	6
Tsang et al., 2006	?	+	-	+	?	+	+	4
Schmitz-Hubsch et al., 2006	+	-	-	-	+	+	+	4
Tsang et al., 2003	?	?	?	?	?	+	+	2

Note **+** : Low risk of bias; **?** : Unclear risk of bias; **-** : High risk of bias (mean score for risk of bias is 4.2)

Table 3. Exploratory Comparisons of Subgroup Differences in Physical and Functional Ability

Subgroups	Studies (n)	Subjects (n)	SMD (95% CI)	*p* value of overall effect	I^2 (%)	*p* value of heterogeneity	*p* value of group differences
Physical Ability							
Type of Intervention							
Health Qigong	5	376	0.58 (0.21, 0.94)	.002	65	.02	.62
Liuzijue, Yijinjing, Dantian Qigong	4	380	1.08 (0.04, 2.12)	.04	95	<.001	
Yoga, exercise therapy, daily walk	3	267	0.51 (-0.06, 1.08)	.08	81	.005	
Duration of Entire Intervention							
=4320 minutes	3	295	1.37 (-0.05, 2.79)	.06	96	<.001	.29
1500-2000 minutes	4	285	0.68 (0.43, 0.92)	<.001	47	.13	
≤1080	3	226	0.38 (0.12, 0.65)	.005	52	.12	
Frequency of Class Weekly							
>3 times	3	260	0.54 (0.03, 1.04)	.04	74	.02	.24
=3 times	3	206	1.65 (0.21, 3.09)	.02	94	<.001	
<3 times	4	340	0.38 (0.16, 0.59)	<.001	44	.15	
Type of Control Intervention							
Active	6	522	0.67 (0.05, 1.29)	.03	91	<.001	.53
Usual care, wait list	7	546	0.96 (0.33, 1.59)	.003	91	<.001	
Quality of the Study							
Some risk of bias	5	392	0.84 (-0.15, 1.83)	.09	95	<.001	.60
Low risk of bias	6	464	0.57 (0.38, 0.76)	<.001	12	.34	
Functional Ability							
Type of Qigong Exercise							
Health Qigong	4	261	0.57 (0.32, 0.82)	<.001	0	.49	.18
Liuzijue, Yijinjing, Dantian Qigong	3	293	0.81 (0.55, 1.06)	<.001	97	<.001	

SMD=standardized mean difference

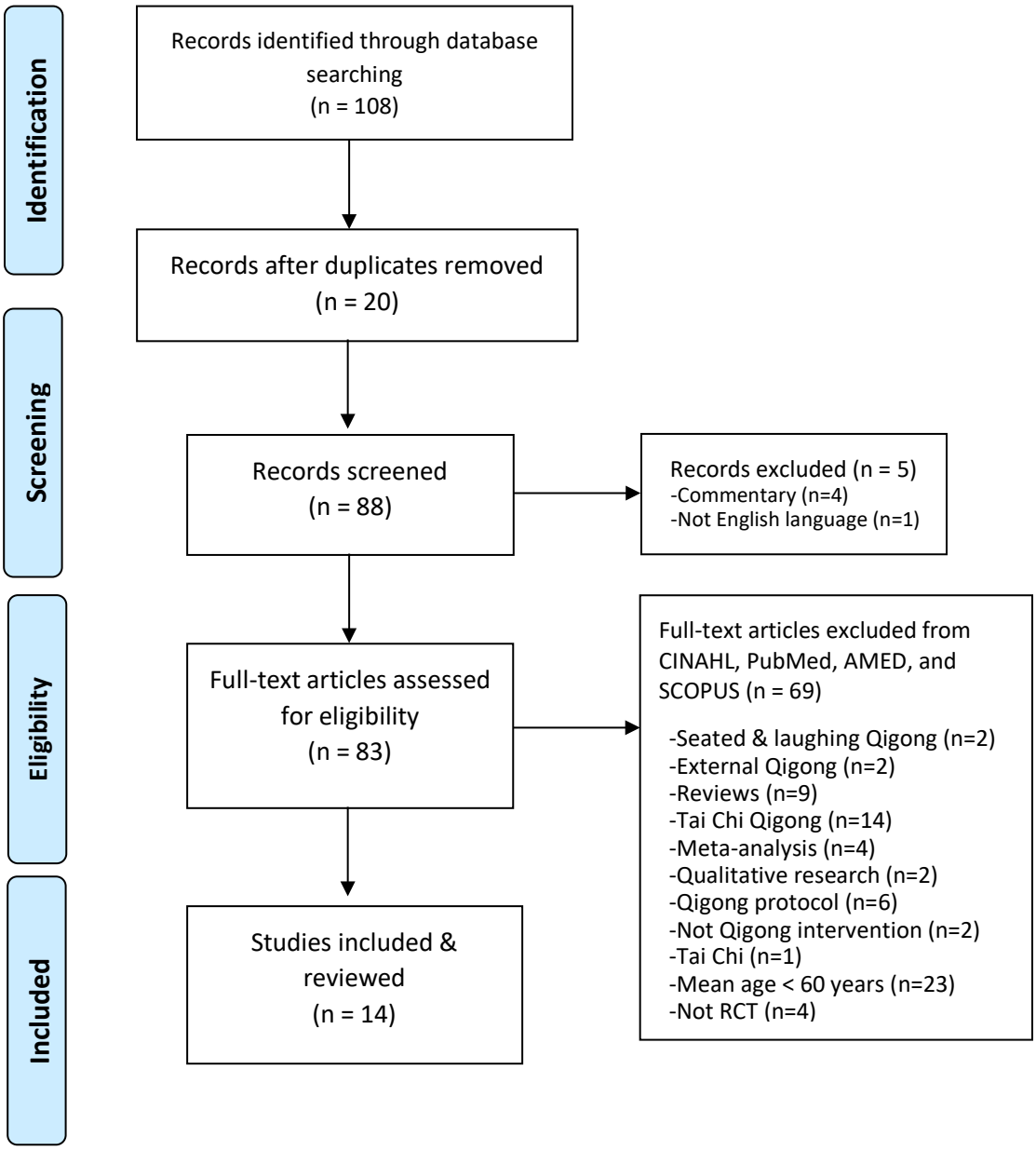
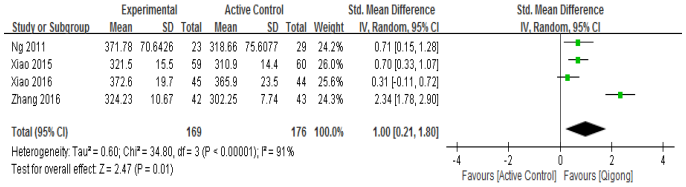
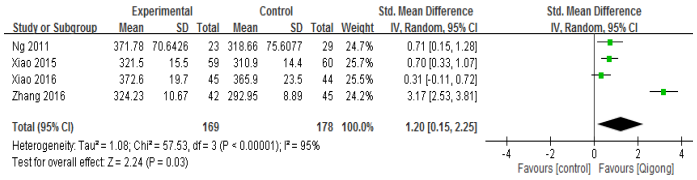

Identification
Screening
Eligibility
Included
Records identified through database searching (n = 108)
Records after duplicates removed (n = 20)
Records screened (n = 88)
Records excluded (n = 5)
-Commentary (n=4)
-Not English language (n=1)
Full-text articles assessed for eligibility (n = 83)
Full-text articles excluded from CINAHL, PubMed, AMED, and SCOPUS (n = 69)
-Seated & laughing Qigong (n=2)
-External Qigong (n=2)
-Reviews (n=9)
-Tai Chi Qigong (n=14)
-Meta-analysis (n=4)
-Qualitative research (n=2)
-Qigong protocol (n=6)
-Not Qigong intervention (n=2)
-Tai Chi (n=1)
-Mean age < 60 years (n=23)
-Not RCT (n=4)
Studies included & reviewed (n = 14)

Figure 1

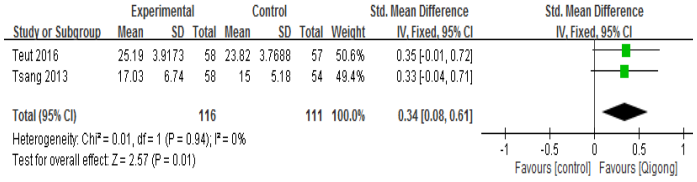
a



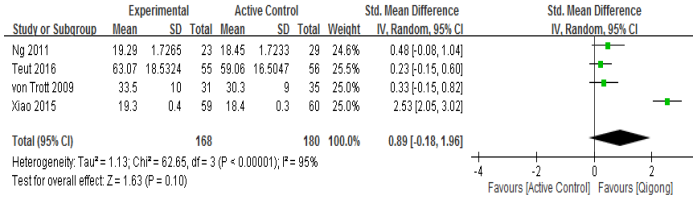
b



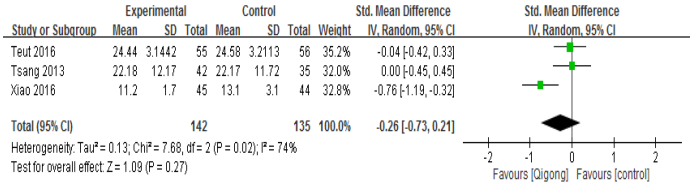
c



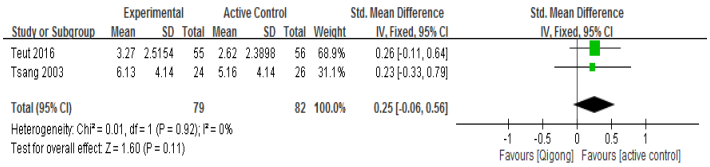
d



e



f



g

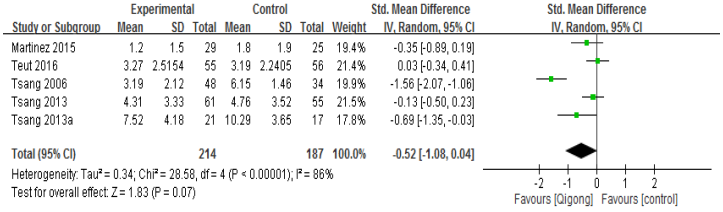


Figure 2